Vertical Marginal Discrepancy of Retrievable Cement/Screw-retained Design and Cement-retained Implant-supported Single Metal Copings

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Running title: Marginal discrepancy of implant-supported metal copings

ABSTRACT

Aim: To compare the vertical marginal discrepancy of retrievable cement/screw-retained design (RCSRD) and cement-retained (CR) implant-supported single metal copings cemented on implant abutments.

Materials and methods: Single metal copings were fabricated for twenty 4.5 x 10 mm titanium dental implants. Two groups of ten implants each were randomly allocated. One group received RCSRD metal copings and the other group received CR metal copings. Both types of restorations were fabricated on solid abutments with 5.5 mm of diameter. The copings were cemented with resin cement. After the cementation procedure, cement excess was carefully removed in both groups. Inspections of coping-abutment vertical marginal discrepancy were measured using scanning electronic microscopy (SEM) under 800X magnification. The independent sample student t-test was used to detect differences between groups ($P<.05$).

Results: RCSRD implant-supported metal coping group (57.80 ± 2.34 μm) showed statistically better vertical marginal discrepancy than CR implant-supported metal coping group (64.40 ± 2.23 μm) ($P=.001$).

Conclusion: RCSRD implant-supported metal copings offer less vertical marginal discrepancy than CR copings group. This new technique would decrease the marginal discrepancy with less bacterial filtration and biomechanical problems.

Clinical significance: Retrievable cement/screw-retained design is another alternative technique for dental implant rehabilitation that combines the advantages of cement-retained and screw-retained prostheses. The hybrid design offers less vertical marginal discrepancy for better control of bacterial filtration and biomechanical problems.

Key words: dental implants**,** dental marginal adaptation, dental prosthesis, implant-supported

INTRODUCTION

Dental implants are an effective treatment option for partially or totally edentulous patients and the success is directly related to the osseointegration process, functional performance and biologic integration of prosthetic components.[1-3]

Traditionally, implant-supported fixed dental prostheses (FDP) are retained by either cementing them over an abutment or attaching them to the implant through a screw.[4] Both types of restorations have different advantages and disadvantages.[5,6] Even more, a pertinent literature review stated that when screw-retained (SR) and cement-retained (CR) prostheses were compared, survival rates were similar, soft/hard tissue levels and responces were comparable, and zirconia offered esthetic advantages for both prostheses.[7] However, the residual cement at the implant-abutment interface is the principal disadvantage of CR prosthesis and produce infiltration, inflamation, and implant failure.[8,9] Moreover, a systematic review stated that comparing the two alternatives, CR prosthesis has more biological and technical complications.[10]

In dentistry the concept of vertical marginal discrepancy (VMD) is the quantity of interface between the prosthesis and the abutment once joined through a screw or dental cement. This is one of the most important key factor to attain long-term success of implant-supported FDP because inadequated VMD could cause bacterial leakage, plaque accumulation, and peri-implant mucositis.[11] In the literature, some authors recommended a VMD of less than 120 μm after copings cementation as

origially suggested for fixed prosthesis.[12] In addition, an in vitro study reported VMD from 63.6 μm in non-cemented cast copings, to 116.1 μm after cast copings cementation.[13] However, SR prosthesis shows always the best marginal discrepancy because no cement is used.[14]

Looking for improvements of implant-supported FDP, both traditional techniques were fused in a new alternative technique called retrievable cement/screw-retained design (RCSRD) implant-supported prosthesis that combines the advantages of CR and SR prostheses.[15-18] This prosthesis has an screw access hole and allows the use of cement (retrievable design). In addition, the RCSRD has two exit areas to remove excess of cement, one is the screw access hole and the other one the marginal interface, offering more control of remnant cement. Another advantages are the possibility to clean the remnant cement excess, to polish the abutment-restoration interface, and could make more comfortable the prosthetic maintenance,[19] which is ideal for periodontal patients. In the literature, some clinical studies reported about RCSRD.[20, 21] However, the VMD has not be determined considering scanning electronic microscope (SEM) that allows exploring the entire perimeter with high accuracy.

Hence, the objective of this in vitro study was to use SEM to compare the VMD of RCSRD and CR single copings after have been cemented with resin on implant abutments.

MATERIAL AND METHODS

This in vitro study was performed at Faculty of Health Sciences of the Universidad Cientifica del Sur, Lima, Peru. The specimens consisted of 20 single copings. The sample size was determined by a pilot test of 10 specimens (5 specimens each) using the formula to compare two means with a 95% confidence level, a statistical power of 90%, an accuracy of 5.06 micrometers (μm), and a variance of 7.52 μm. According to this result and a preliminary study,[14] 10 specimens were evaluated per group.

Twenty cylindrical morse taper implant, with a diameter of 4.5 mm and 10 mm in length (Super Line Implant; FX 4510 SW, Dentium, Seoul, South Korea) were connected to a 20 titanium hexagonal abutment (AAB 1054550 HL, Dentium, Seoul, South Korea) with a 5.5 mm in diameter, 8.5 mm in length, 2 mm in collar height, and 6º of taper. The implants were randomly divided into two groups (n=10): cement-retained (CR) and retrievable cement/screw-retained design (RCSRD).

Cement-retained copings (group CR)

The abutments were sandblasted with 110 μm of pure aluminum oxide particles (Duostar Z, Bego, Moscow, Russia) under a pressure of 0.4 MPa to create an opaque surface. The abutments were scanned using an extra oral scanner (Autoscan-DS200 Dental 3D scanner, China) to create a virtual CAD/CAM model pattern. The frameworks of the single prosthesis were designed using a 3D shape dental software (3shape Dental Designer, 3shape A/S, Copenhagen, Denmark) following the program recommendations as follows: 0.5 mm thickness for all axial

walls and 40 μm for cement space in all the intaglio surface, and this information was stored in the template library file for both groups.

The frameworks were sintered with sintering laser selective machine (Concept Laser Hofmann, Lichtenfels, Germany). The Remanium® star CL powered (Co 60.5%, Cr 28%, W 9%, Si 1.5%, other elements <1 %: Mn, N, Nb, Fe Dentaurum, Ispringen, Germany) was slightly melted with a high temperature laser. Approximately a layer of 20 μm width was formed until the framework was completed. This procedure was performed for all the specimens. All this procedures were done by an expert dental technician.

Retrievable cement/screw-retained design copings (group RCSRD)

A similar procedure described for group CR was followed. Additionally, a screw access hole was placed at the center of the occlusal surface using a software. The diameter of the screw access hole represented the screw abutment diameter (2 mm).

Metal copings cementation on implant abutments

In group CR the abutment screws were torqued at 35 Ncm using a torque wrench (SCB 10 IT, Dentium, Seoul, South Korea) as recommended by the manufacturer. Later, the abutment screw channels were filled with cotton pellets (Fig. 1A) and an impression of the internal coping surface was made with polyvinyl siloxane material (Putty, Panasil®, Heerfeld, Eschenburg, Germany).[22] After, resin cement (RelyX U200 A_2, 3M ESPE, Minnesota, USA) was applied to the axial walls of the copings and prior to light curing, the prostheses were seated on the silicone

abutment replicas for cement film reduction (Fig. 1B). Then, the copings were placed on the abutments using finger pressure for 10 sec (Fig. 1C). Finally, light cured was achieved using a photopolymerization lamp (Litex 682, 3M Dentamerica INC, Pasippany, USA) with 20 seconds per surface at 600 mW/cm^2.

The abutments of the group RCSRD were screwed on their analogs (Dentium, Seoul, South Korea). After, the abutment screw channels were filled with cotton pellets (Fig. 2A) and the copings were extraorally cemented on the abutments using the resin cement. Cement excess was removed with a N° 12 blade and the interface coping-abutment was polished (Universal Polishing Paste, Ivoclar Vivadent, Schaan, Germany) (Fig. 2B). Later, the copings cemented on the abutments were placed in the implants, the occlusal screws were torqued and cotton pellets were placed in the screw access holes before adhesive application with disposable brushes (3M, Minnesota, USA). Finally, the screw access holes were sealed with composite resin (Filtek^{TM} Z350 XT Universal Restorative, 3M ESPE, Minnesota, USA) and were light cured with the same photopolymerization lamp (Fig. 2C). All this procedures were done by the investigator.

Vertical marginal discrepancy (VMD)

The specimens were stabilized on the lingual surface using a resin (Fig. 3A). This stabilization allowed a correct visualization of the interface at the vestibular surface that was confirmed with a digital light microscope under x40 magnification (Model T-1050, Ken-A-Vision, Kansas, USA). Each specimen was marked at the center of the vestibular surface with a black point using a marker (Fig. 3B) in order to identify the first surface evaluated. After, the measurements were made parallel

to the coping-abutment interface at three predetermined reference points at the mid-buccal, mid-mesial, and mid-distal side of each abutment. Finally, the averages of these three measurements were considered as the VMD value.

Then, all the specimens were measured using a scanning electron microscope (SEM) (Model Inspect S50, FEI, Oregon, USA) without any previous sample preparation. The images were obtained under the following conditions: Using a secondary electron detector, 800X magnification, a spot at 5.0, and images scale of 100 μm (Fig. 4A and 4B). Each specimen was randomly allocated and all measurements were made by an expert microscopy technician that store the data in a spreadsheet.

Statistical analysis

The analysis was performed using SPSS 24 (SPSS Inc., Armonk, NY, USA) software for windows. The Shapiro-Wilk test corroborated the normal distribution of the data. Then, mean values of VMD for both groups were compared by independent sample student t-test to detect statistically significant differences between groups ($P < .05$).

RESULTS

Table 1 displays the descriptive statistics (mean, standard deviation, median, minimum, maximum, and variance) of the VMD values for each implant-supported prosthesis (RCSRD and CR). The highest VMD values were obtained in the CR group (64.40 ± 2.23 μm) whereas the lowest VMD values were obtained in the

RCSRD group (57.80 ± 2.34 μm). Table 2 shows the inferential statistics. The independent sample t-test indicated that VMD values were significantly different (P=.001) among the 2 groups. The RCSRD group (57.80 ± 2.34 μm) had significantly the lowest VMD values in comparison to CR group (64.40 ± 2.23 μm), respectively.

DISCUSSION

Marginal discrepancy is a key factor for the long-term function of implant-supported restorations in oral environment because it promotes clinical success and prosthesis durability.[23] The objective of this in vitro study was to compare the VMD of RCSRD and CR single copings after have been cemented with resin on implant abutments.

According with Holmes et al.,[24] VMD is defined as the misfit measured parallel to the path of draw of the casting. However, in the literature we can find studies about absolute marginal discrepancy,[25] marginal and internal fit,[26] and vertical marginal fit,[23] for the marginal accuracy evaluation of compounds cemented or sitted on implants.

The results of the present study showed a statistical significant difference in the VMD between RCSRD (57.80 ± 2.34 μm) and CR (64.40 ± 2.23 μm) cast copings cemented on implant abutments. One study with similar methodology evaluated VMD of CR metal-ceramic crowns on implant abutments using stereomicroscope.[14] These authors reported a VMD of 54.4 ± 18.1 μm before cementation, 57.4 ± 20.2 μm after crown cementation using glass-ionomer cement, and 67.4 ± 15.9 μm using zinc phosphate. However, the images had low resolution and the limits between the abutment and the cast were unclear which might interfere with the VMD

measurement. In contrast, the present study used SEM to quantify the VMD and this in a recommended method for marginal discrepancy evaluation.[27]

Although no consensus has been reached on the exact level of discrepancy considered acceptable for implant frameworks, several investigations[12,13] have reported that VMD values below 120 μm are clinically acceptable. On the other hand, some literature proposed VMD of 63.6 μm or less in CR implant-supported prosthesis[28] even though mean values below 30 μm have been difficult to achieve clinically using conventional ceramic crowns.[29]

A combined retrievable technique called RCSRD prosthesis was described. This prosthesis is cemented on its abutment and has an access hole to be screwed to an implant. This should allow the removal of the prosthesis outside the dental implant without the necessity of the crown destruction. According with the results of the present study, RCSRD group showed better VMD than CR group leading to less bacterial leakage and excess cement remaining that could have less biological problems.

The copings were fabricated through an additive method called selective laser sintering (SLS), which is being increasingly used as a new technology in oral rehabilitation. In addition, Kim et al.[30] compared the marginal discrepancy of metal copings produced with subtractive method (milling soft metal blocks), additive method (SLS) and traditional method (lost wax and casting). These authors concluded that marginal discrepancy with aditive (SLS) and substractive methods were more accurate than the traditional lost wax and casting methods. Moreover, another study[31] compared the marginal discrepancy of metal-ceramic crowns using

SLS method and tradictional Co-Cr casting and concluded similar values of better results using SLS.

An important consideration for marginal discrepancy evaluation is the finish line type of the abutment because an abutment with a shoulderless finish line would decrease the marginal discrepancy compared to an abutment with a chamfer finish line.[20] For that, in the present study, chamber finish line abutments were used for easy identification in the microscopy evaluation.

According with the RCSRD fabrication, the abutment has a screw access hole opened on the outside.[15-17, 19-21] A disadvantage of this prosthesis is that the screw access hole could affect the resistance of the ceramic. Nevertheless, an in vitro study compared the fracture resistance between CR and RCSRD prostheses and no significant differences were found in the fracture resistance.[31] In adition, da Rocha et al.[32] has reported that the screw access hole has no significant effect on prosthesis retention.

An important limitation of this study was to achieve the correct stabilization of the specimens since the prosthesis-abutment interface had to be viewed from a strict perpendicular plane. However, a digital light microscope was used to verify the perpendicular position of the prosthetic-abutment interface before performing the analysis with the SEM. Another limitation was that the specimens were not subjected to a physiological fatigue load or thermocycling. However, currently there is no consensus on the need for thermocycling in the evaluation of in vitro studies.[33]

The findings of the present study suggest that the VMD in RCSRD implant-supported single copings might be more accurate than CR implant-supported on

dental implants abutments. Future research with in vivo study design and long-term follow-up should assess clinical performance in relation to peri-implant health before promoting recommendation of the RCSRD implant-supported prosthesis.

CONCLUSION

RCSRD implant-supported metal copings offer less vertical marginal discrepancy than CR copings group. This new technique would decrease the marginal discrepancy with less bacterial filtration and biomechanical problems.

CONFLICTS OF INTEREST: The authors stated that they have no conflict of interest.

REFERENCES

1. Chochlidakis K, Einarsdottir E, Tsigarida A, Papaspyridakos P, Romeo D, Barmak AB, et al. Survival rates and prosthetic complications of implant fixed complete dental prostheses: An up to 5-year retrospective study. J Prosthet Dent 2020 Jan. [Epub ahead of print].

2. Del Fabbro M, Testori T, Kekovic V, Goker F, Tumedei M, Wang HL. A Systematic Review of Survival Rates of Osseointegrated Implants in Fully and Partially Edentulous Patients Following Immediate Loading. J Clin Med 2019 Dec 8(12); E2142. [Epub ahead of print].

3. Pitta J, Zarauz C, Pjetursson B, Sailer I, Liu X, Pradies G. A Systematic Review and Meta-Analysis of the Influence of Abutment Material on Peri-implant Soft Tissue Color Measured Using Spectrophotometry. Int J Prosthodont 2020 Jan;33(1):39-47.

4. Wittneben JG, Joda T, Weber HP, Bragger U. Screw retained vs. cement retained implant-supported fixed dental prosthesis. Periodontol 2000 2017 Feb;73(1):141-151.

5. Sailer I, Muhlemann S, Zwahlen M, Hammerle CH, Schneider D. Cemented and screw-retained implant reconstructions: a systematic review of the survival and complication rates. Clin Oral Implants Res 2012 Oct;23 (Suppl 6):163-201.

6. Gomez-Polo M, Ortega R, Gomez-Polo C, Celemin A, Del Rio Highsmith J. Factors Affecting the Decision to Use Cemented or Screw-Retained Fixed Implant-Supported Prostheses: A Critical Review. Int J Prosthodont 2018 Jan;31(1):43-54.

7. Priest G. A Current Perspective on Screw-Retained Single-Implant Restorations: A Review of Pertinent Literature. J Esthet Restor Dent 2017 May;29(3):161-171.

8. Gapski R, Neugeboren N, Pomeranz AZ, Reissner MW. Endosseous implant failure influenced by crown cementation: a clinical case report. Int J Oral Maxillofac Implants 2008 Sep;23(5):943-946.

9. Pauletto N, Lahiffe BJ, Walton JN. Complications associated with excess cement around crowns on osseointegrated implants: a clinical report. Int J Oral Maxillofac Implants 1999 Nov;14(6):865-868.

10. Wittneben JG, Millen C, Bragger U. Clinical performance of screw- versus cement-retained fixed implant-supported reconstructions--a systematic review. Int J Oral Maxillofac Implants 2014 Jan;29 (Suppl):84-98.

11. Nascimento C, Ikeda LN, Pita MS, Pedroso e Silva RC, Pedrazzi V, Albuquerque RF, et al. Marginal fit and microbial leakage along the implant-abutment interface of fixed partial prostheses: An in vitro analysis using Checkerboard DNA-DNA hybridization. J Prosthet Dent 2015 Dec;114(6):831-838.

12. Martinez-Rus F, Ferreiroa A, Ozcan M, Pradies G. Marginal discrepancy of monolithic and veneered all-ceramic crowns on titanium and zirconia implant abutments before and after adhesive cementation: a scanning electron microscopy analysis. Int J Oral Maxillofac Implants 2013 Mar;28(2):480-487.

13. Koc E, Ongul D, Sermet B. A comparative study of marginal fit of copings prepared with various techniques on different implant abutments. Dent Mater J 2016 Jan;35(3):447-453.

14. Keith SE, Miller BH, Woody RD, Higginbottom FL. Marginal discrepancy of screw-retained and cemented metal-ceramic crowns on implants abutments. Int J Oral Maxillofac Implants 1999 May;14(3):369-378.

15. AlHelal A, Kattadiyil MT, AlBader B, Clark JL. A Protocol for Screw-Retrievable, Cement-Retained, Implant-Supported Fixed Partial Dentures. Int J Prosthodont 2017 Nov;30(6):577-580.

16. Proussaefs P, AlHelal A. The combination prosthesis: A digitally designed retrievable cement- and screw-retained implant-supported prosthesis. J Prosthet Dent 2018 Apr;119(4):535-539.

17. Rajan M, Gunaseelan R. Fabrication of a cement- and screw-retained implant prosthesis. J Prosthet Dent 2004 Dec;92(6):578-580.

18. Malpartida-Carrillo V, Tinedo-Lopez PL, Ortiz-Culca F, Guerrero ME, Amaya-Pajares SP. Techniques for retrievability and for registering screw access holes in cement-retained implant-supported prostheses: A scoping review of the literature. J Prosthet Dent 2020 Mar;123(3):427-433.

19. Singh R, Mahesh L, Shukla S. Extra oral cementation of implant prosthesis: a case report. J Indian Prosthodont Soc 2013 Dec;13(4):627-630.

20. Canullo L, Cocchetto R, Marinotti F, Oltra DP, Diago MP, Loi I. Clinical evaluation of an improved cementation technique for implant-supported restorations: a randomized controlled trial. Clin Oral Implants Res 2016 Dec;27(12):1492-1499.

21. Nissan J, Snir D, Rosner O, Kolerman R, Chaushu L, Chaushu G. Reliability of retrievable cemented implant-supported prostheses. J Prosthet Dent 2016 May;115(5):587-591.

22. Wadhwani C, Pineyro A. Technique for controlling the cement for an implant crown. J Prosthet Dent 2009 Jul;102(1):57-58.

23. Lo Russo L, Caradonna G, Biancardino M, De Lillo A, Troiano G, Guida L. Digital versus conventional workflow for the fabrication of multiunit fixed prostheses: A systematic review and meta-analysis of vertical marginal fit in controlled in vitro studies. J Prosthet Dent 2019 Nov;122(5):435-440.

24. Holmes JR, Bayne SC, Holland GA, Sulik WD. Considerations in measurement of marginal fit. J Prosthet Dent 1989 Oct;62(4):405-408.

25. Rosas J, Mayta-Tovalino F, Guerrero ME, Tinedo-Lopez PL, Delgado C, Ccahuana-Vasquez VZ. Marginal Discrepancy of Cast Copings to Abutments with Three Different Luting Agents. Int J Dent 2019 Jun;2019:8657582.

26. Uribarri A, Bilbao-Uriarte E, Segurola A, Ugarte D, Verdugo F. Marginal and internal fit of CAD/CAM frameworks in multiple implant-supported restorations: Scanning and milling error analysis. Clin Implant Dent Relat Res 2019 Oct;21(5):1062-1072.

27. Groten M, Girthofer S, Probster L. Marginal fit consistency of copy-milled all-ceramic crowns during fabrication by light and scanning electron microscopic analysis in vitro. J Oral Rehabil 1997 Dec;24(12):871-881.

28. Siadat H, Alikhasi M, Mirfazaelian A, Zade MM. Scanning electron microscope evaluation of vertical and horizontal discrepancy in cast copings for single-tooth implant-supported prostheses. Implant Dent 2008 Sep;17(3):299-308.

29. Martinez-Rus F, Suarez MJ, Rivera B, Pradies G. Evaluation of the absolute marginal discrepancy of zirconia-based ceramic copings. J Prosthet Dent 2011 Feb;105(2):108-114.

30. Kim KB, Kim JH, Kim WC, Kim JH. Three-dimensional evaluation of gaps associated with fixed dental prostheses fabricated with new technologies. J Prosthet Dent 2014 Dec;112(6):1432-1436.

31. Derafshi R, Farzin M, Taghva M, Heidary H, Atashkar B. The Effects of New Design of Access Hole on Porcelain Fracture Resistance of Implant-Supported Crowns. J Dent (Shiraz) 2015 Mar;16(1 Suppl):61-67.

32. da Rocha PV, Freitas MA, de Morais Alves da Cunha T. Influence of screw access on the retention of cement-retained implant prostheses. J Prosthet Dent 2013 Apr;109(4):264-268.

33. Gale MS, Darvell BW. Thermal cycling procedures for laboratory testing of dental restorations. J Dent 1999 Feb;27(2):89-99.

FIGURES

Figure 1A to C: Representative specimen showing the procedure for CR implant-supported metal coping cementation: (A) Screw abutment channel filled with cotton pellets; (B) Casting set up on the silicone abutment replicas prior to light curing; (C) Cast placement on the abutment using finger pressure.

Figure 2A to C: Representative specimen showing the procedure for RCSRD implant-supported metal coping cementation: (A) Screw abutment channel filled with cotton pellets; (B) Coping-abutment interface polishing; (C) Composite resin light-cured.

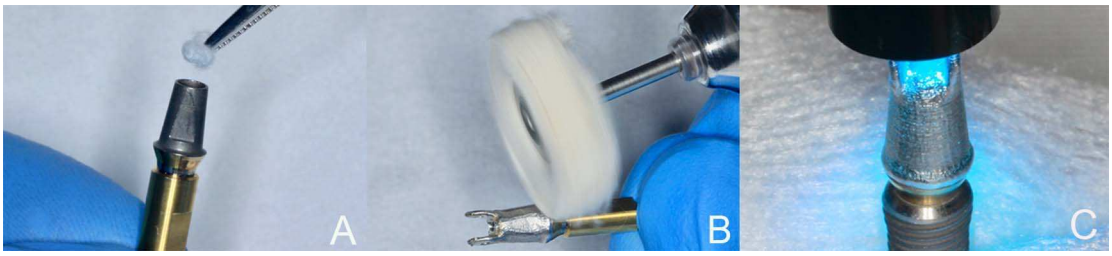


Figure 3A and B: Representative specimens' stabilization to evaluate the VMD: (A) Representative specimens of retrievable cement/screw-retained design and cement-retained implant-supported copings; (B) Black points placement at the center vestibular surface of the specimens.

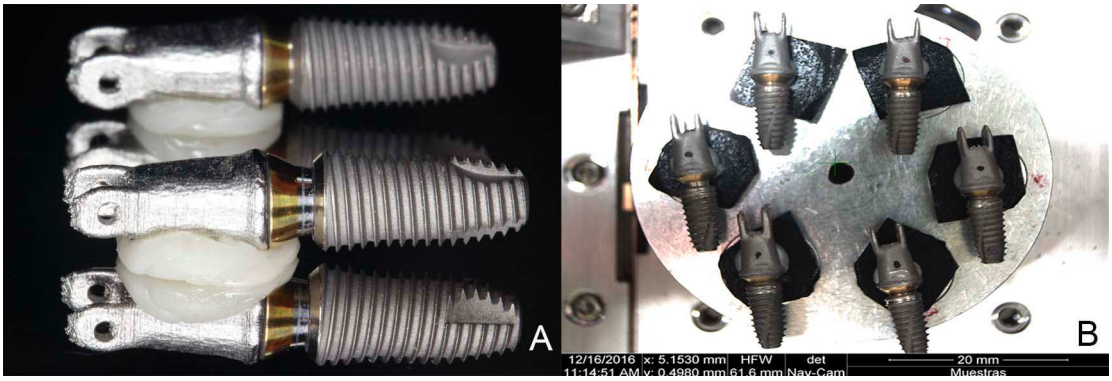
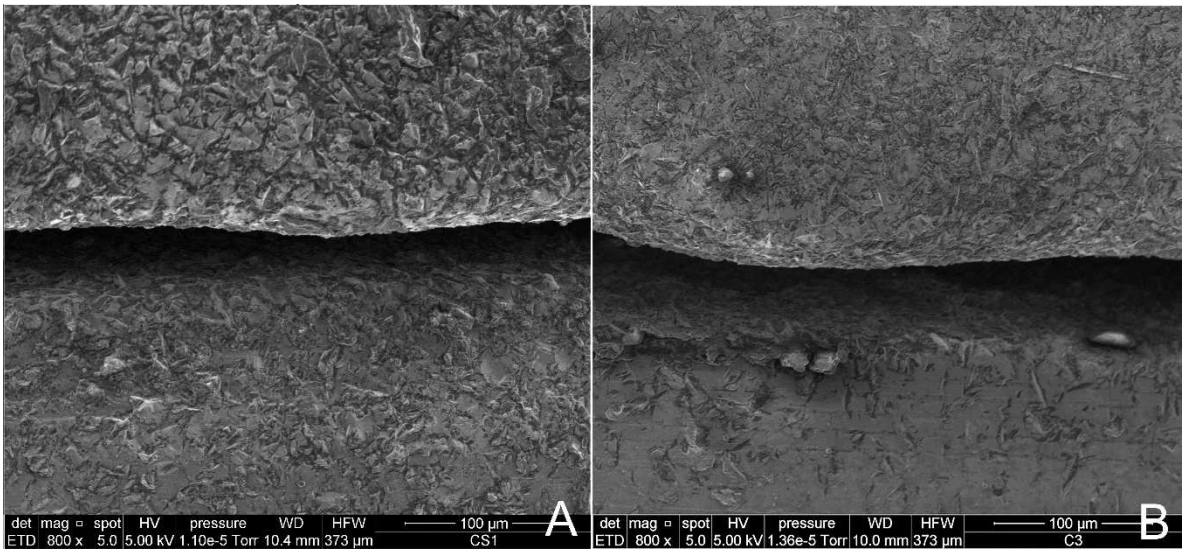


Figure 4A and B: Representative SEM images after vertical marginal discrepancy measurement: (A) Retrievable cement/screw-retained design implant-supported metal coping; (B) Cement-retained implant-supported metal coping.



TABLES

Table 1. Vertical marginal discrepancy evaluation of RCSRD and CR implant-supported single metal copings cemented on implant abutments

Implant-retained prosthesis	N	Unit	Mean	SD	Median	Minimum	Maximum	Variance
RCSRD	10	µm	57.80	2.34	57.13	54.41	61.57	5.49
CR	10	µm	64.40	2.23	64.34	59.78	67.43	5.01

RCSRD, Retrievable cement/screw-retained design prosthesis

CR, Cement-retained prosthesis

Table 2. Comparison of the VMD between RCSRD and CR implant-supported single metal copings cemented on implant abutments

Implant-retained prosthesis	N	Unit	Mean	SD	95% IC		P VALUE
					Lower	Superior	
RCSRD	10	µm	57.80	2.34	56.13	59.48	0.001*
CR	10	µm	64.40	2.23	62.80	66.00	

RCSRD, Retrievable cement/screw-retained design prosthesis

CR, Cement-retained prosthesis

* Indicates significant difference (independent samples *t* test, $p = 0.001$)